CHAPTER 2.2 - Toxicity Reduction Evaluations

This chapter is intended to provide guidance to aid dischargers and their consultants when conducting a toxicity reduction evaluation (TRE). Included is a description of basic steps that are often included in a TRE and outlines of reports that need to be submitted to the Department.

NOTICE: This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

General Discussion - What Is A TRE?

The terms “toxicity reduction evaluation” (TRE) and “toxicity identification evaluation” (TIE) are often used interchangeably, separately, or together (as in "TI/RE"), which often creates confusion. A TRE is the complete evaluation intended to determine those actions necessary to remove toxicity. This often includes steps to identify the source(s) of toxicity, and steps designed to identify the changes needed to reduce or remove that toxicity. A TRE may identify a simple solution such as improved housekeeping procedures or require a more extensive investigation to identify cost-effective treatment or source reduction options. A TIE is one step in the TRE, where effluent samples are manipulated to remove suspect compounds and then re-tested to see if toxicity remains.

The first step of a TRE is the collection of data and facility-specific information, in order to define study objectives, identify what is known, and provide clues as to the cause(s) of toxicity. The next step involves the review of facility housekeeping practices, treatment plant operation, and the selection and use of process and treatment chemicals, in an attempt to identify/reduce potential sources of toxicity. If none of these practices is identified as the source of toxicity, a TIE may be done. The objective of the TIE is to characterize and identify the compound(s) causing toxicity so that they can be traced back to their source. Once the cause (i.e., chemical compound) and/or source (i.e., the contributor of the causal agent) is identified, the TRE process usually goes in one of two directions. One approach is to evaluate options for treating the final effluent, the other is to identify the source(s) of toxicity and then evaluate upstream pretreatment options, source reduction, or process modifications. A decision can be made to pursue both approaches, and then to select the most technically and economically attractive option.

Flexibility in the design of a toxicity reduction evaluation (TRE) is essential, mostly because of the differences between production/influent sources, treatment processes, and wastewater effluents. Since every discharge situation is different, the approach needed to investigate potential sources of toxicity is usually different, too. However, there are some investigative techniques and approaches that are common to many TREs. The guidance provided here is intended to describe general approaches which have been successfully used in the past by Wisconsin labs and permittees. Department staff may provide helpful advice, but ultimately it is up to the permittee, with help from their lab or consultant, to develop a TRE plan and determine what is necessary to identify and remove toxicity. Communication and cooperation between the permittee and the Department is essential in TRE plan development, review, and implementation and will help ensure achievement of the TRE objective.

WET Limits/Compliance Schedules Driven by Limited Data or Intermittent Toxicity. Federal (GLI) and state regulations may sometimes require that a WET limit be given when a small number of WET failures have occurred in the past, even if toxicity has not occurred in the effluent for some time or if toxicity is not always present in the effluent. This type of situation may occur more frequently with Great Lakes basin dischargers, due to the stringent WET reasonable potential procedures in the Great Lakes Water Quality Implementation Guidance (see Chapter 1.3, page 28), which may require a WET limit in the event of a single WET test failure.

Although past WET failures suggest that there is reasonable potential for receiving water impacts from the effluent due to toxicity, which requires the imposition of a WET limit, TREs are much more difficult to perform when toxicity is no longer present or occurs infrequently. In these types of situations, a successful TRE may simply include WET monitoring that shows that toxicity in past tests is no longer present (even if the reason for the disappearance is unknown). If no toxicity occurs during monitoring performed during the TRE period, it will not be possible for past sources of toxicity to be identified. If monitoring done during the permit term (during the TRE and after) shows that toxicity is no longer present in the discharge, it may be possible to argue that older WET failures are no longer representative of the discharge (i.e., the WET limit may not be required in the next reissuance).

When Is A TRE Necessary?

The Department strongly encourages permittees to begin toxicity reduction evaluations (TREs) as soon as their effluent has shown severe or repeated bouts of toxicity. When an effluent has shown a severe or persistent toxicity problem, the Department has the authority to modify or reissue the permit to include additional WET monitoring and/or WET limits, since the potential for exceedance of water quality standards exists. If there is evidence that a severe or persistent toxicity problem may exist in an effluent at the time of permit reissuance, the Department usually has no choice but to reissue that permit with a WET limit and compliance schedule that requires the permittee to find and fix the source(s) of that toxicity. However, when possible, the Biomonitoring Team prefers to allow permittees to try to fix the problem on their own, without modifying or reissuing the permit with a WET limit. In this way, the Biomonitoring Team and the permittee can avoid potential complications and time restrictions that may occur when WET limits and compliance schedules are placed in permits.

Whether voluntary or permit-required, TRE studies should be well thought out and study objectives and results well documented and communicated to the Department. This chapter was created in order to provide some guidance regarding the basic information expected in TRE plans and reports. The primary purpose of TRE plans and reports are to inform the Department about the work to be done or work that has been done to identify the source(s) of toxicity. It is important to remember that although TRE plans and reports are intended primarily for the Department, others (WDNR permits staff, local government, public, industry, environmental groups, etc.) will need to read and understand them as well. Technical portions of TRE plans and reports should be written so that the general public can understand them.

Toxicity Reduction Evaluation Plans and Reports

The submittal and completeness of TRE plans and reports required by WPDES permits is the responsibility of the permittee, even if parts or the whole are written by consultants (i.e., toxicity testing labs or engineering consultants). **The following guidance describes the TRE plans and reports required by WPDES permits, but can also be used by permittees who are doing a voluntary (not permit-required) TRE.** In order for everyone to fully understand the goals and intent of the TRE, plans should include specific steps to be taken, specific dates when each step is to be completed, and a description of what each step is meant to accomplish. In order to help permittees and their consultants design plans and reports, some general outlines of information that should be included are given in the following pages.

In order for permit-required TRE plans and reports to be approved by the Department, they should include the information given below for each step. The Department does recognize that each TRE will be facility specific, some of the areas outlined may not apply in some situations, and that in some cases more or different information may be necessary. Communication and cooperation between the permittee and the Department is essential in TRE plan development, review, and implementation and will help ensure achievement of the TRE objective.

A TRE is usually divided into two parts: 1) identification of toxicity and 2) removal of toxicity. These parts are separated because decisions on the most appropriate way to remove toxicity are dependent on the cause(s). The

standard WET limit compliance schedule (described in Chapter 1.12 and shown below) is set up so that sufficient time is allowed for part one and part two of the TRE to be completed. Described below are descriptions of the steps included in the standard WET limit compliance schedule, which usually appears in WPDES permits when a new WET limit is given. The guidance below include descriptions of TRE plans and reports that must be submitted to the Department.

STEP ONE

Standard WET Limit Compliance Schedule

Required Action	Date Due
Submit part one of a Toxicity Reduction Evaluation (TRE) plan describing procedures to be used to identify the source(s) responsible for the effluent toxicity.	See due dates in WPDES permit
Implement part one of the TRE plan, make a reasonable attempt to identify the source(s) of the toxicity, and submit a report to the Department presenting the results of the evaluation.	
Submit part two of the TRE Plan describing actions to be taken to reduce or eliminate the toxicity identified in part one of the TRE and the dates by which those actions will be implemented.	
Submit a progress report identifying the actions taken to date to implement part two of the TRE plan.	
Complete all actions identified in the TRE plan and achieve compliance with the effluent toxicity limitation.	

Step One: Submittal of Part One of the TRE Plan

The first step of every TRE should be for the permittee to develop a include a plan describing actions to be taken to investigate sources of toxicity. The first step in the standard WET limit compliance schedule (if required in the permit), usually requires that a plan like this be submitted to the Department, usually within 2-3 months of permit reissuance. These "part 1 TRE plans" should include: a description of tasks to be done to identify the source(s) of toxicity (e.g., industry, commercial, domestic), a schedule for conducting these tasks, relevant background information, objectives of the study, and scheduled completion dates and milestones. The following is an outline of suggested information to be included in these plans (see also the discussion under "Implementation of the TRE Plan" for specific tasks that may be included in part one of a TRE):

1. Introduction. *(1-2 pages)*

A. Narrative description of past WET Tests, toxicity identification work done to date (if any)

B. Summary *(tables, graphs, etc.)* of specific WET test results, TIE work done (if any)

2. Outline or flowchart of study. *(1-2 pages)*

A. Timelines for when each phase of the work is expected to be done.

B. Discussion of data gathering & review, facility-specific investigations, etc. that are to be done

1) Review of in-house data *(effluent data, operational records, additive/treatment chemical use, etc.)*

2) Field data collection *(inventory of hauled wastes/influents, industrial/commercial user surveys, etc.)*

C. Discussion of Phase I, II, and II TIE steps planned *(usually more detail regarding Phase I, Phase II & II in general terms, since they're dependent on results of previous Phase).*

3. Toxicity Identification Evaluation (TIE) & other laboratory investigation steps. *(4-5 pp)*

A. Species used, type *(acute or chronic, screening vs. dilution series, etc.)* & frequency of tests

B. Description of TIE manipulations - what's done, what results mean if a reduction in toxicity is noted *(1-2 paragraphs on each manipulation)*

1) Initial toxicity tests *(if applicable)*

2) Baseline tests *(if applicable)*

3) pH adjustment *(if applicable)*

4) filtration *(if applicable)*

5) aeration *(if applicable)*
6) C_{18}/SPE *(if applicable)*
7) sodium thiosulfate/oxidant reduction *(if applicable)*
8) EDTA chelation *(if applicable)*
9) any additional selected

4. Reporting timelines for the project *(1-2 pages)*

A. Description of when progress reports will be made to the permittee and the Department
B. Dates when Phase I, II, & III reports will be due *(options include separate dates for each as they are completed or one final report when all work is finished)*
C. Date when report is expected *(on or before next date specified in compliance schedule)*

5. Summary, potential future work *(1-2 pages)*

Other steps can be taken to identify toxicity sources. The permittee and their lab/consultant may be the best source of ideas for these additional steps. The Biomonitoring Team and other Department staff can assist permittees, where possible. Since the Biomonitoring Coordinator has a comprehensive view of ongoing and past TREs, their advice may be useful. Permittees should provide regular updates during the TRE, in order to insure that studies are proceeding as planned. ***Communication and cooperation between the permittee and the Department is essential in TRE plan development, review, and implementation and will help ensure achievement of the TRE objective.***

Things To Avoid When Planning Or Conducting A TRE:

1. **Reliance on "gut feelings" & "trial and error" studies.** Since TIEs are expensive, some often narrow their search by limiting studies to look for sources they "feel" may be the cause. If this is done, care should be taken to insure that TIE steps are being eliminated based on reliable information, not just feelings. While toxicity sources may be identified through a trial and error approach, the cost of doing so may quickly surpass the cost of a more organized TRE.

2. **Reliance on priority pollutant scans.** Toxicity may be caused by compounds which don't appear on chemical analysis lists or may be caused by a combination of compounds. Priority pollutant scans may provide helpful information to supplement TIE tests, but shouldn't be relied on to provide all of the answers.

3. **Confirmation steps not carried out for identification or treatability studies** Money can be wasted if conclusions are rushed and not confirmed before treatment options are considered.

4. **Quick solutions without modifying ongoing behavior.** Solutions to toxicity should become standard operating procedure. TRE activities should not be once in time, but continuing activities.

STEP TWO

Standard WET Limit Compliance Schedule

Required Action	Date Due
Submit part one of a Toxicity Reduction Evaluation (TRE) plan describing procedures to be used to identify the source(s) responsible for the effluent toxicity.	See due dates in WPDES permit
Implement part one of the TRE plan, make a reasonable attempt to identify the source(s) of the toxicity, and submit a report to the Department presenting the results of the evaluation.	
Submit part two of the TRE Plan describing actions to be taken to reduce or eliminate the toxicity identified in part one of the TRE and the dates by which those actions will be implemented.	
Submit a progress report identifying the actions taken to date to implement part two of the TRE plan.	
Complete all actions identified in the TRE plan and achieve compliance with the effluent toxicity limitation.	

Step Two: Implementation of Part One of the TRE Plan and Submittal of a Report

Following the plan submitted in step one, the permittee should begin investigating the sources of effluent toxicity. The first step of a TRE is usually the collection of data and facility-specific information. This step is used to define study objectives, identify what is known, and provide clues as to the cause(s) of toxicity. This information may also suggest immediate actions which may be useful in reducing effluent toxicity. The next step involves optimization of facility operations in an attempt to reduce effluent toxicity. Three areas are usually investigated during this step: facility housekeeping, treatment plant operation, and the selection and use of process and treatment chemicals.

After it has been established that sampling protocols, facility housekeeping, treatment plant operations, and treatment chemicals are not causing toxicity, a toxicity identification evaluation (TIE) is often done. The objective of the TIE is to characterize and identify the compound(s) causing toxicity so that they can be traced back to their source. In a TIE, effluent samples are taken to the WET lab, where they can be manipulated to remove suspect chemicals (e.g., metals, organics, etc.) and then re-tested to see if toxicity remains. If a specific effluent manipulation removes toxicity, then the researcher has a clue about the chemical(s) causing the toxicity. The evaluation can use both characterization procedures and chemical-specific analyses, therefore, the identifications may range from generic classes of toxicants to specific chemical compounds. Multiple samples are usually needed for a TIE and one objective of a TIE may be to determine if and how toxicity varies over time. Once a specific class or individual compound has been identified as a potential cause of the toxicity, the investigation turns towards finding the source (e.g., contributing industrial process, commercial source, etc.) of that compound.

Specific tasks that may be done during part one of a TRE may include:

- **Data Gathering.** TREs usually begin with information gathering and study of on-site situations. Data gathering steps may include: 1) checking effluent data to see if other limits were exceeded or operational upsets may have occurred at the same time as effluent toxicity; 2) identifying potential sources of toxicity within the production process or wastewater treatment plant, such as cleaning or disinfection agents, process sidestreams (e.g. sludge thickener super/subnatant, digester decant, etc.), or additives (e.g. biocides, polymers, flocculants, surfactants, etc.); 3) looking for significant levels of individual chemicals in the combined wastestream (using pretreatment data, Merck index, or other chemical references) and 4) inventorying what is entering the sewer system by industry, commercial, domestic, & batch loads accepted by the headworks or elsewhere. Attachment 1 at the end of this chapter includes an example "Industrial/Commercial User Survey", which is one way to collect this information.

- **Public and Employee Education.** Public education is becoming more important in toxicity reduction for municipal dischargers. Employee education regarding proper disposal and use of process and treatment chemicals has also reduced toxicity in some instances. Commonly used household pesticides and cleaners have been implicated at many POTWs as sources of toxicity. Educating the public and employees about environmental and monetary costs of improper disposal of toxic substances can reduce toxicity in some instances. In many cases, toxicity has disappeared from a municipal effluent after efforts were made to educate the public about proper disposal of household chemicals.

- **Facility Housekeeping And Optimization Of Facility Operation.** It is important to verify that process chemicals are not overused, housekeeping practices are not contributing wastes directly to the effluent, and other facility practices are not contributing to toxicity. Three areas are usually investigated during this step: 1) facility housekeeping (see Attachment 2 "Housekeeping Logic Flow"), 2) treatment plant operation (see Attachment 2 "Treatment Plant Optimization Logic Flow"), and 3) the selection and use of process and treatment chemicals. One can attempt to determine what operational adjustments could be made that could reduce toxicity, such as increasing aeration basin detention time, sludge age,

etc. and develop a scheme for testing how such adjustments in process control may reduce toxicity in the effluent (allowing time at each adjusted setting to ensure several detention times to occur plant-wide).

- **Find A Qualified Lab/Consultant.** Permittees often rely on past consultants to solve toxicity problems, which may not be appropriate since not all consultants have experience with TRE work. The quality of the work being done is entirely dependent on the experience and knowledge that the lab or consulting firm can bring to the project. The best way to choose a lab that is up to the challenge is to talk to other permittees who have performed TREs, in order to determine which labs have been the most successful at identifying toxic substances. One should identify labs that have had success identifying the cause(s) during these studies, and separate those from investigations that were long and costly without identifying the cause(s). TIEs vary greatly, depending on the amount and type of work needed, but in 1997 cost estimates from one lab were $2000.00 (per sample) for an acute TIE and $4000.00 (per sample) for a chronic TIE. Permittees should not limit their search to local labs, since lab work is usually much more expensive than shipping costs. The Department cannot officially endorse or recommend labs or consultants, but can identify those that have performed TREs successfully in the past (see Appendix 5 of the WET Guidance Document). It is crucial to the success of the TRE that consulting firms and labs chosen to help have staff who have experience with TREs and in the formulation of overall study plans.

- **Check For Sampler Contamination.** Sampling locations and gear should be checked for possible toxic contributions and to see whether equipment was new and/or properly cleaned prior to testing. (see Chapter 1.1 for guidance on sampler cleaning). Sampler contamination and sampling procedures can also be studied by conducting concurrent tests with different samplers or different WET labs.

- **Additional Monitoring To Demonstrate Absence Of Toxicity.** In some cases, toxicity may be infrequent, disappear inexplicably, or have been removed by actions taken prior to initiation of the TRE. In these cases, permittees may wish to demonstrate that toxicity is no longer present by conducting some additional WET tests. These tests should be performed using the procedures specified in the WPDES permit. The number of tests required to make this demonstration will depend on factors such as the seasonality, severity, and cause(s) of toxicity. If toxicity does not occur during this monitoring, the permittee may ask the Department to modify the permit to remove or change the remaining steps in the compliance schedule, the WET limit, and/or subsequent WET monitoring requirements.

- **Toxicity Identification Evaluations (TIE).** TIE methods include bench-top treatment steps designed to indicate the general types of compounds that are causing effluent toxicity. Initial toxicity tests are performed to determine if samples are toxic, then manipulations for removal or alteration of effluent toxicity are performed and the resulting treated samples are tested for toxicity. The physical/chemical characteristics are indicated by the treatment steps that reduce toxicity relative to a baseline test. It is recommended that the full suite of Phase I procedures be performed on effluent samples. As information is obtained on the nature and variability of toxicity, additional tests may focus on the steps that are successful in affecting toxicity.

- **Test Frequency/Most Sensitive Species.** TIEs require that toxicity be present so that toxicants can be characterized and identified. Enough testing should be done to assure consistent presence of toxicants for characterization. In order to reduce costs, it may be wise to do more frequent "screening" tests (100% effluent only) to determine if toxicity is present, rather than full dilution series less frequently. Tests may also be limited to the species shown to be the most sensitive in previous WET tests. It is assumed that by removing toxicity to the most sensitive species, you remove toxicity to others as well.

- **Alternative Toxicity Tests.** At times it may be desirable to do less costly testing before starting

complex TIE studies. For example, some investigations have included alternative toxicity tests (e.g., Microtox® or other alternate species), to determine when toxicity was present (e.g., night-time hours, only when an industry was discharging, etc.) or to find out which wastestream(s) was most toxic (e.g., industry, commercial, domestic).

- **Phase I TIE,** (*Methods For Aquatic Toxicity Identification Evaluations, Phase I Toxicity Characterization Procedures or Methods For Aquatic Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents)* Phase I methods characterize the physical/chemical nature of the components of the effluent that are causing toxicity. Such characteristics as solubility, volatility, and filterability are determined without specifically identifying toxicants. Results are usually a first step in specifically identifying the toxicants but the data generated can also be used to develop treatment methods to remove toxicity without specific identification of the toxicants.

- **Phase II And Phase III TIE,** (*Methods For Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity; Methods For Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity),* Phase II methods specifically identify toxicants if they are non-polar organics, ammonia, or metals. Phase III methods confirm the suspected toxicants.

- **Toxicity Source Evaluation.** Once effluent toxicants have been identified, steps should be taken to locate their source(s). This evaluation may include a review of existing pretreatment data or data from the collection and analysis (chemical-specific and/or toxicity) of additional samples from industrial users. Information gathered from an "Industrial and Commercial User Survey" (see Attachment 1) can be invaluable at this point in the TRE.

Part 1 Report

The following is an outline of suggested information to be included in a part 1 TRE Report. In order to comply with permit-required compliance schedules, this report should include: a description of specific tasks done to identify the source(s) of toxicity (e.g., industry, commercial, domestic) and any relevant background information.

1. Introduction. *(1-2 pages)*

A. Description of data gathering/analyses, education efforts, and facility-specific investigations done
B. Summary of specific WET test results, TIE work done
C. General discussion of Phase I, II, and II steps completed and conclusions reached
D. Any deviations from "normal" WET test procedures *(e.g., feeding schedules, temperatures, pH control, aeration, etc.)* should be highlighted

2. Results of Toxicity Identification Evaluation & other laboratory investigation steps. *(4-5 pp.)*

A. Discussion of test type used *(acute/ chronic, screening vs. dilution series, etc.)* and frequency of tests
B. Description of specific TIE manipulations - what was done, what results were and what they mean *(1-2 paragraphs on each manipulation - should contain tables showing survival and growth/reproduction results from each manipulation, when appropriate)*

3. **Toxicity Source Evaluation.**

A. Review of existing pretreatment data or data from the collection and analysis (chemical-specific and/or toxicity) of additional samples from industrial users. Information gathered from an "Industrial and Commercial User Survey" should be reported. Conclusions reached as to the specific industrial, commercial, or other source(s) of effluent toxicity should be discussed.

4. Summary & Conclusions *(1-2 pages)*

A. Summary of work done to identify source(s) responsible for toxicity and what results indicate.
B. Identification of potential source(s) *(e.g., industrial, commercial, internal to WWTP)* of toxicity, based on data review and collection, frequency & duration of toxicity, TIE work.

STEP THREE

Standard WET Limit Compliance Schedule

Required Action	Date Due
Submit part one of a Toxicity Reduction Evaluation (TRE) plan describing procedures to be used to identify the source(s) responsible for the effluent toxicity.	See due dates in WPDES permit
Implement part one of the TRE plan, make a reasonable attempt to identify the source(s) of the toxicity, and submit a report to the Department presenting the results of the evaluation.	
Submit part two of the TRE Plan describing actions to be taken to reduce or eliminate the toxicity identified in part one of the TRE and the dates by which those actions will be implemented.	
Submit a progress report identifying the actions taken to date to implement part two of the TRE plan.	
Complete all actions identified in the TRE plan and achieve compliance with the effluent toxicity limitation.	

Step Three: Submittal of Part Two of the TRE Plan

The third step of the standard compliance schedule usually requires the permittee to develop a plan describing actions to be taken to investigate ways to remove the source(s) of toxicity. In order to comply with the third step of the compliance schedule, part two of the TRE plan should include: a description of tasks to be done to identify alternatives for removing/reducing toxicity, a schedule for conducting these tasks, background information from part one of the TRE, identification of those conducting the evaluation (e.g., lab, consultants, etc.), objectives of the study, and scheduled completion dates and milestones. The following is an outline of suggested information to be included in these plans:

1. Introduction. *(1-2 pages)*

A. Narrative description of toxicity identification work done & results shown
B. Summary *(tables, graphs, etc.)* showing specific WET test results, TIE work done *(optional)*

2. Outline or flowchart of study. *(1-2 pages)*

A. General description of plan to investigate ways of reducing or eliminating toxicity, including an evaluation of options for treating the final effluent and an evaluation of upstream pretreatment options, source reduction, and/or process modifications.
B. Timelines for when each phase of the work is expected to be done.

3. Toxicity Reduction Evaluation (TRE) & other investigation steps. *(4-5 pages)*

A. Discussion of studies to be done to identify toxicity removal alternatives, which may include:
   1) Source reduction alternatives
   2) Assessment of the treatment options: trials of modified treatment procedures in existing works or the evaluation of different procedures or works through bench or pilot scale simulation
   3) Cost/benefit analysis *(factors such as cost effectiveness and long term effects should be considered when choosing the best alternative)*

B. Tests to confirm toxicity removal
   1) Tests should be done according to procedures specified in the permit.
   2) Number of tests will depend on seasonality, severity, and cause of original toxicity *(usually 3 or 4 tests, performed at least 60 days apart, is sufficient)*.

4. Reporting timelines for the project *(1-2 pages)*

A. Description of when progress reports will be made to the permittee and the Department

B. Compliance schedule for installment of pretreatment *(when applicable)*
C. Date when final report is expected *(on or before date specified in last step of compliance schedule)*

5. Summary, potential future work *(1-2 pages)*

STEPS FOUR AND FIVE

Standard WET Limit Compliance Schedule

Required Action	Date Due
Submit part one of a Toxicity Reduction Evaluation (TRE) plan describing procedures to be used to identify the source(s) responsible for the effluent toxicity.	See due dates in WPDES permit
Implement part one of the TRE plan, make a reasonable attempt to identify the source(s) of the toxicity, and submit a report to the Department presenting the results of the evaluation.	
Submit part two of the TRE Plan describing actions to be taken to reduce or eliminate the toxicity identified in part one of the TRE and the dates by which those actions will be implemented.	
Submit a progress report identifying the actions taken to date to implement part two of the TRE plan.	
Complete all actions identified in the TRE plan and achieve compliance with the WET limit.	

Steps Four & Five:
Implementation of Part 2 of the TRE and Submittal of Progress & Final Reports

Once the cause (i.e., chemical compound) and/or the primary source(s) of toxicity (e.g., industry, commercial, domestic, etc.) have been identified, decisions on the most appropriate approach for removing toxicity need to be made. To do this, the TRE process usually goes in one of two directions. One approach is to evaluate options for treating the final effluent, the other is to evaluate upstream pretreatment options, source reduction, or process modifications. A decision can also be made to pursue both approaches, and then to select the most technically and economically attractive option. This work was planned during the third step of the compliance schedule and must be completed in order to meet the WET limit which will become effective at the end of the compliance schedule.

A progress report is usually required about half way through part 2 of the TRE, in order to allow for mid-course corrections, if needed. This report should contain what has been learned to date regarding treatability, reduction, or removal options. If an alternative has been selected (e.g., pretreatment), the report should include a detailed schedule for when implementation is expected (e.g., a compliance schedule for installing pretreatment). This report should also include information regarding whether the TRE is on track to meet final compliance schedule dates.

Specific tasks that may be done during part two of a TRE may include:

- **Investigating Alternatives For Removing Toxicity.** Once the source has been identified, it is necessary to investigate ways of reducing or eliminating the toxicity. While source reduction of toxicants should be the preferred method of toxicity reduction, a concurrent or alternative approach is the assessment of the treatment of toxicity. Cost/benefit decisions often drive decisions between source reduction or treatment. Paths taken to address treatability most often take the form of either trials of modified treatment procedures in existing works or the evaluation of different procedures or works through bench or pilot scale simulation.

- **Choosing The Best Toxicity Control Alternative.** Criteria for the selection of preferred toxicity control options should include: 1) compliance with WET limits, 2) compliance with other environmental regulations (sludge, air, solid & hazardous waste, etc.), 3) capital, operational, and maintenance costs, 4) ease of implementation, 5) reliability, and 6) environmental impact (not necessarily in that order). Cost may often be the driving factor, however, *the selected option should offer the best potential for consistent, reliable toxicity reduction with the least environmental impact*.

- **Performing Tests To Confirm Toxicity Removal.** Once the appropriate toxicity control option has been chosen and implemented, it will be necessary to perform WET tests to demonstrate that toxicity has been reduced to an acceptable level or eliminated altogether. WET tests should be performed using procedures specified in the permit. The number of tests required to make this demonstration will depend on factors such as seasonality, severity, and cause(s) of toxicity. Usually, four tests (performed at least 60 days apart) are sufficient.

Final Report & WET Limit Compliance

The following is an outline of suggested information to be included in the final TRE Report. In order to comply with permit-required compliance schedules, this final report should include: a description of work that was done to remove the source(s) of toxicity and any relevant background information.

1. Introduction. *(1-2 pages)*

A. Narrative description of toxicity identification & reduction work done

B. Summary of specific WET test results, TIE work done *(optional)*

2. Results of Toxicity Reduction Evaluation (TRE) & other investigation steps. *(4-5 pages)*

A. Discussion of studies done to find most cost effective toxicity removal alternative(s)

B. Results of WET Tests competed to confirm toxicity removal

3. Summary & Conclusions *(1-2 pages)*

A. Report of which toxicity removal alternatives were chosen, why they were chosen, and whether or not they were successful *(based on results of WET Tests competed to confirm toxicity removal).*

Additional Guidance: The *USEPA also provides TRE guidance, titled "TRE Guidance for Municipal Wastewater Treatment Plants" (EPA/833/B-99/002, 8/99) and "Generalized Methodology for Conducting Industrial TREs" (EPA/600/2-88/070, 4/89). These documents give hints about designing and conducting TREs and case studies illustrating approaches used successfully by others. They do a good job of describing steps that should be considered when doing a TRE and provide more detail than given here. These documents are recommend reading for those doing a TRE on complex wastewaters, are non-technical and easy to understand. For copies, visit USEPA's on-line library at http://cave.epa.gov/cgi/nph-bwcgis/BASIS/ncat/pub/ncat/sf or contact: USEPA Office of Research & Development, Cincinnati, OH, (513) 569-7562.*

EXAMPLE INDUSTRIAL/COMMERCIAL USER SURVEY

(City/village/town) is performing a toxicity reduction evaluation, since toxicity test results have indicated the presence of substances in the effluent that are potentially harmful to aquatic life. In order to reduce or eliminate effluent toxicity, (city/village/town) must identify and locate its source. As a part of this investigation, (city/village/town) is conducting a survey of industrial and commercial dischargers that may contribute toxic substances to the wastewater treatment facility. This questionnaire has been prepared to assist (city/village/town) in gathering information for this purpose. Please complete the form by filling in answers to the following questions, and provide a copy to (city/village/town). Use additional sheets as necessary.

1. Name and Address of Business:

2. Who should be contacted at your facility for additional information?

Name: _____ Telephone No.: _____

3. Product(s) manufactured or service(s) performed:

4. What is your average volume discharge to the sanitary sewer system in gallons per day?

5. Does your discharge to the sanitary sewer system include process or cleaning-sanitizing wastewater other than normal sanitary wastewater from rest rooms and employee facilities? If yes, please provide the average and peak daily volumes of process wastewater discharged to the wastewater treatment facility. Include any discharge other than restroom and employee facility wastewater. YES ( ) NO ( )

******IF NO, YOU MAY DISREGARD THE REMAINING QUESTIONS ON THIS FORM***

6. Attach copies of any wastewater analytical data from your facility which has been collected in the last five years. Identify whether such data is for your entire discharge or for samples from your process wastewater flow(s) only (specify which flows).

7. Does your facility store any raw materials, cleaners, etc., used in your production processes, which contain any of the pollutants listed on the attached toxic pollutant list? If yes, what specific compounds or formulations (indicate volumes stored)? YES ( ) NO ( )

8. Do you use any substances containing any of the substances on the attached sheet in production or cleanup activities (e.g., sanitizers, cleaning agents, cooling water additives, etc.) If yes, please provide a list of all substances used and a copy of the Material Safety Data Sheets (MSDS) for each substance. Also, please provide the following information for any compounds or formulations identified: name of pollutant and containing compound, process compound used in, and amount of compound used per month. YES ( ) NO ( )

9. Are there particular days of the week and/or times of the day when potentially toxic discharges from your facility may be highest? If so, please describe by providing peak day to average ratios, peak hourly concentrations and flow rates, etc., to the extent this information may be available. YES ( ) NO ( )

Your assistance with this survey is appreciated. If you have questions, or need additional information, please call _____ at the (name and phone no. of facility).

TOXIC SUBSTANCES LIST
INDUSTRIAL/COMMERCIAL USER SURVEY
(sorted by priority pollutant category)

Metals:
Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Cyanide
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

Volatile Organic Compounds:
Acrolein
Acrylonitrile
Benzene
Bromoform
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
2-Chloroethyl vinyl ether
Chloroform
1,2-Cisdichloroethylene
Dichlorobromomethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
(vinylidene chloride)
1,2-Transdichloroethylene
1,2-Dichloropropane
1,1-Dichloropropene
2,3-Dichloropropene
1,3-Dichloropropene
Ethylbenzene
Methyl Bromide
Methyl Chloride
Methylene Chloride
Pentachlorophenol
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
Toxaphene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl Chloride

Acid-Extractable Compounds:
P-Chloro-M-Cresol
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
4,6-Dinitro-O-Cresol
2,4-Dinitrophenol
2-Nitrophenol
4-Nitrophenol
Phenol
2,4,6-Trichlorophenol

Base-Neutral Compounds:
Acenaphthene
Acenaphthylene
Anthracene
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
3,4-Benzofluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chlorisopropyl)ether
Di(2-ethylhexyl)phthalate (DEHP)
4-Bromophenyl Phenyl Ether
Butyl benzyl phthalate
2-Chloronaphthalene
4-Chlorophenyl Phenyl Ether
Chrysene
Dibenzo(a,h)anthracene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
Diethyl Phthalate
Dimethyl Phthalate
Di-n-butyl Phthalate
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octyl Phthalate
1,2-Diphenylhydrazine
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
Naphthalene
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosodipropylamine
N-Nitrosodiethylamine
N-Nitrosodi-n-butylamine
N-Nitrosopyrrolidine
Octachlorostyrene
Pentachlorobenzene
Phenanthrene
Pyrene
1,2,3,4-Tetrachlorobenzene
1,2,4,5-Tetrachlorobenzene
1,2,4-Trichlorobenzene

Pesticides:
Aldrin
Alpha-BHC
Beta-BHC
Delta-BHC
Chlordane
Chlorpyrifos
Dieldrin
4,4'-DDD
4,4'-DDE
4,4'-DDT
Endrin
Parathion
Diazinon
2,4-Dichlorophenoxyacetic acid
Endosulfan
Endosulfan Sulfate
Endrin Aldehyde
Guthion
Heptachlor
Heptachlor Epoxide
Malathion
Methoxychlor
PCBs

Dioxin:
2,3,7,8-TCDD (dioxin)

Other Pollutants:
Aluminum
Ammonia
Asbestos
BHC-tech. grade
Bis(2-chloromethyl)ether
Chloride
Chlorine
3-Chlorophenol
4-Chlorophenol
Dichlorodifluoromethane
2,3-Dichlorophenol
2,5-Dichlorophenol
2,6-Dichlorophenol
3,4-Dichlorophenol
1,3-Dichloropropane
2,3-Dinitrophenol
Fluoride
Formalin
Gamma-BHC
Iron
2-Methyl-4-Chlorophenol
3-Methyl-6-Chlorophenol
Mirex
Photomirex
2,3,4,6-Tetrachlorophenol
Trichlorofluoromethane
2,4,5-Trichlorophenol